

What is claimed is:

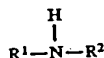
~~1. A lubricating composition comprising a major amount of lubricating oil, an oil soluble molybdenum compound providing about 100 to 450 parts per million of molybdenum, said molybdenum compound selected from the group consisting of a sulfur and phosphorus free organic amide molybdenum complex and a molybdenum carboxylate wherein the carboxylate anion has from about 4 to 30 carbon atoms and about 750 to 5,000 parts per million of an oil soluble secondary diarylamine.~~

~~2. The composition of claim 1 wherein the carboxylate is that of a monocarboxylic aliphatic acid having from about 4 to 18 carbon atoms or an alicyclic acid having from about 4 to 12 carbon atoms.~~

~~3. The composition of claim 1 wherein the diarylamine has from about 6 to 30 carbon atoms in each of the aryl groups.~~

~~4. The composition of claim 1 wherein at least one of the aryl groups is alkaryl having from 7 to 20 carbon atoms in the alkyl group.~~

~~5. The composition of claim 1 wherein the secondary diarylamine is of the formula:~~



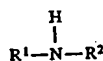
~~wherein R<sup>1</sup> and R<sup>2</sup> each independently represent an aryl group having from about 6 to 30 carbon atoms.~~

~~6. The composition of claim 1 wherein: the molybdenum carboxylate is that of an aliphatic acid having from about 4 to 18 carbon atoms or an alicyclic acid having from 4 to 12 carbon atoms; each of the aryl groups of the amine is a member selected from the group consisting of phenyl, naphthyl, alkphenyl wherein the alkyl portion has from about 4 to 18 carbon atoms and alknaphthyl wherein the~~

~~alkyl portion has about 4 to 18 carbon atoms; the quantity of molybdenum is from about 100 to 250 parts per million; and the quantity of amine is from about 1.000 to 4.000 parts per million.~~

7. A method for improving the antioxidancy and friction properties of a lubricant which comprises including in the lubricant, a molybdenum compound which provides about 100 to 450 parts per million of molybdenum said molybdenum compound selected from the group consisting of a sulfur and phosphorus free organic amide molybdenum complex and a molybdenum carboxylate wherein the carboxylate anion has from about 4 to 30 carbon atoms and about 750 to 5.000 parts per million of an oil soluble secondary diarylamine.

8. The method of claim 7 wherein the amine is of the formula



wherein each of  $\text{R}^1$  and  $\text{R}^2$  is alkphenyl having from about 4 to 18 carbon atoms in each alkyl group.

9. The method of claim 8 wherein the molybdenum carboxylate is prepared from an acid having from 4 to 18 carbon atoms and the quantity of molybdenum from the molybdenum carboxylate is from about 100 to 250 parts per million and the quantity of the amine is from about 1,200 to 3,000 parts per million.

10. The method of claim 9 wherein the acid is a monocarboxylic saturated fatty acid.

11. The method of claim 8 wherein the molybdenum carboxylate is molybdenum 2-ethylhexanoate.

12. The method of claim 7 wherein the molybdenum compound is a sulfur and phosphorus free organic amide molybdenum complex.

13. A lubricating oil concentrate prepared by dissolving a total of from about 2.5 to 90 parts by weight of an oil soluble molybdenum compound selected from the group consisting of a sulfur and phosphorus free organic amide molybdenum complex and a molybdenum carboxylate derived from an organic carboxylic acid having about 4 to 30 carbon atoms and an oil soluble secondary diarylamine dissolved in 10 to 97.5 parts of a solvent wherein the weight ratio of molybdenum to amine is from about 0.02 to 0.6 parts of molybdenum for each part of amine.

14. The concentrate of claim 13 wherein the solvent is a mineral oil or synthetic oil and the ratio of molybdenum to amine is from about 0.04 to 0.4 parts of the molybdenum for each part of the amine, the molybdenum carboxylate is that of a monocarboxylic aliphatic acid having from about 4 to 18 carbon atoms or an alicyclic acid having from 4 to 12 carbon atoms, and at least one of the aryl groups of the amine is alkaryl having from 7 to 20 carbon atoms in the alkyl group.

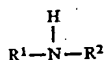
15. The concentrate of claim 13 wherein one or more of the following additives are further present: a dispersant; a detergent; and a zinc dihydrocarbyl dithiophosphate.

16. A lubricating oil composition prepared by mixing an oil soluble molybdenum compound selected from the group consisting of a sulfur and phosphorus free organic amide molybdenum complex and a molybdenum carboxylate derived from monocarboxylic acids selected from the group consisting of aliphatic acids having about 4 to 18 carbon

~~atoms, alkylic acids containing from 4 to 12 carbon atoms~~  
and aromatic acids containing from 7 to 14 carbon atoms and  
an oil soluble secondary diaryl amine in a lubricating oil  
wherein the concentration of the molybdenum in the oil is  
from about 100 to 450 parts per million and the concentra-  
tion of the amine in the oil is from about 750 to 5,000 parts  
per million based on said composition.

17. The lubrication composition of claim 16 wherein:

- A. the molybdenum compound is a molybdenum carboxylate of an aliphatic acid having from 4 to 18 carbon atoms and the concentration thereof is from about 100 to 250 parts per million of the composition; and
- B. the diaryl amine is of the formula:



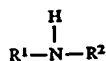
wherein  $\text{R}^1$  and  $\text{R}^2$  each independently represent an aryl group having from about 6 to 30 carbon atoms and the concentration thereof is from about 1,000 to 4,000 parts per million of the composition.

18. The lubrication composition of claim 17 wherein the molybdenum carboxylate is that of a fatty acid having from about 4 to 18 carbon atoms and each of  $\text{R}^1$  and  $\text{R}^2$  of the amine is a member selected from the group consisting of phenyl, naphthyl, alkphenyl having from about 4 to 18 carbon atoms in the alkyl group and alknaphthyl having from about 4 to 18 carbon atoms in the alkyl group.

19. A method for improving the antioxidant and friction properties of a lubricant which comprises adding to the lubricant an oil soluble molybdenum carboxylate derived from an organic carboxylic acid having from about 4 to 30 carbon atoms and wherein said molybdenum carboxylate provides about 100 to 450 parts per million of molybdenum and about 750 to 5,000 parts per million of an oil soluble secondary diarylamine.

20. The method of claim 19 wherein the carboxylate is derived from a carboxylic acid selected from the group consisting of: butyric acid; valeric acid; caproic acid; heptanoic acid; cyclohexanecarboxylic acid; cyclodecanoic acid; naphthenic acid; phenyl acetic acid; 2-methylhexanoic acid; 2-ethylhexanoic acid; suberic acid; octanoic acid; nonanoic acid; decanoic acid; undecanoic acid; lauric acid; tridecanoic acid; myristic acid; pentadecanoic acid; palmitic acid; linolenic acid; heptadecanoic acid; stearic acid; oleic acid; nonadecanoic acid; eicosanoic acid; heneicosanoic acid; docosanoic acid; and erucic acid.

21. The method of claim 20 wherein: the molybdenum carboxylate provides about 100 to 250 parts per million of molybdenum; about 1,000 to 4,000 parts per million of the oil soluble secondary diarylamine are added to the lubricant and said amine is of the formula



wherein each of  $\text{R}^1$  and  $\text{R}^2$  is alkphenyl having from about 4 to 18 carbon atoms in each alkyl group.

Sub 17  
22. A lubricating composition comprising:

a major amount of lubricating oil,

at least one oil soluble molybdenum compound that is at least substantially free of

5 phosphorus and at least substantially free of active sulfur, and

at least one oil soluble secondary diarylamine,

wherein the ratio of said oil soluble molybdenum compound relative to said oil

soluble secondary diarylamine is about 0.02 to 0.6 parts by weight molybdenum per part

of said secondary diarylamine, and said oil soluble secondary diarylamine is present in an

10 amount of at least about 750 to 5,000 parts per million of said lubricating composition.

23. A lubricating composition comprising:

a major amount of lubricating oil,

at least one oil soluble molybdenum compound that is at least substantially free of

15 phosphorus and at least substantially free of active sulfur, and

at least one oil soluble secondary diarylamine,

wherein the ratio of said oil soluble molybdenum compound relative to said

secondary diarylamine is about 0.02 to about 0.6 parts by weight molybdenum per part of

said secondary diarylamine compound and said oil soluble molybdenum compound is

20 present in an amount of about 100 to about 450 parts per million of molybdenum relative

to said lubricating composition.

24. A lubricating composition according to claims 22 or 23, wherein said oil

soluble molybdenum compound is sulfur-free.

25. A lubricating composition according to claim 23, wherein the amount of said secondary diarylamine is about 750 to 5,000 parts per million of said lubricating composition.

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26. A lubricating composition according to claim 22 or 23, wherein the amount of said oil soluble secondary diarylamine is from 1,000 to 4,000 parts per million.

27. A lubricating composition according to claim 22 or 23, wherein the amount of said oil soluble secondary diarylamine is from 1,200 to 3,000 parts per million.

28. A lubricating composition according to claim 22 or 23, wherein molybdenum is present from about 0.040 to 0.4 parts by weight molybdenum relative to said oil soluble secondary diarylamine.

29. A lubricating composition according to claim 22 or 23, wherein molybdenum is present from about 0.05 to 0.3 parts by weight of molybdenum relative to said oil soluble secondary diarylamine.

Sub  
C<sup>20</sup> > ~~30. A lubricating composition according to claim 22 or 23, wherein the molybdenum compound is at least one of molybdenum naphthenate, molybdenum octoate or molybdenum 2-ethylhexanoate.~~

31. A lubricating composition according to claim 22 or 23, wherein the quantity of molybdenum is from 100 to 250 parts per million (by weight).

32. A lubricating composition according to claim 22 or 23, wherein the quantity of molybdenum is from 125 to 250 parts per million (by weight).

33. A lubricating composition according to claim 22 or 23, wherein the molybdenum compound is a molybdenum carboxylate.

34. A lubricating composition according to claim 33, wherein the carboxylate has from 4 to 30 carbon atoms.

35. A lubricating composition according to claim 33, wherein the molybdenum carboxylate is that of an aliphatic or cycloaliphatic acid having from 4 to 18 carbon atoms.

36. A lubricating composition according to claim 33, wherein the carboxylate is that of a monocarboxylic aliphatic or cycloaliphatic acid having an alkyl group of from 6 to 18 carbon atoms.

37. A lubricating composition according to claim 33, wherein the carboxylate is that of a fatty acid.

38. A lubricating composition according to claim 37, wherein the fatty acid has 6 to 14 carbon atoms.

39. A lubricating composition according to claim 22 or 23, wherein said oil soluble molybdenum compound is obtained from a molybdenum source and an active hydrogen compound, said molybdenum source is selected from the group consisting of ammonium molybdates, molybdenum trioxide, and molybdenum acetylacetonates, and said active hydrogen compound is selected from the group consisting of alcohols, polyols, primary amines, secondary amines, polyamines, phenols, ketones, and anilines.

40. A lubricating composition according to claim 22 or 23, wherein said oil soluble molybdenum compound is at least one glycol molybdenum complex.

~~41. A lubricating composition according to claim 22 or 23 wherein the oil soluble molybdenum compound is prepared by: (a) introducing into a reaction zone a compound selected from sulfonates, phenates and salicylates, wherein said compound is an overbased alkaline earth or alkali metal compound; (b) adding to said reaction zone a solvent to solubilize said compound and to form a mixture A; (c) heating said mixture A to an elevated temperature of 49°C or less; (d) preparing an aqueous solution of a molybdenum compound at a temperature of 49°C or less; (e) adding said aqueous solution of said molybdenum compound to said mixture A with stirring during a period of about 15 minutes or less to form a mixture B; (f) adding said mixture B containing said molybdenum compound to a non-polar compound at a temperature of 104°C or greater~~

~~within a period of up to 40 minutes wherein resulting mixture C during said addition is at a temperature of at least 104°C; (g) driving off said water and said non-polar compound as overhead by increasing temperature of said mixture C containing said molybdenum compound to 115°C to 149°C to obtain a water-free composition; (h) adding additional quantity of a non-polar compound to said water-free composition to dilute said composition to clarify said composition by filtration or centrifugation; (i) heating said clarified composition to a temperature of from 149°C to 204°C to remove solvent and said non-polar compound and to recover product comprising an overbased molybdenum-containing alkaline earth metal or alkali metal composition.~~

42. A lubricating composition according to claim 22 or 23, wherein said oil soluble molybdenum compound is at least one organic amide molybdenum complex.

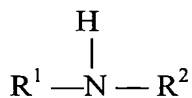
43. A lubricating composition according to claim 22 or 23, wherein said oil soluble molybdenum compound is a molybdenum complex obtained by reacting a fatty oil, diethanolamine and molybdenum source.

44. A lubricating composition according to claim 22 or 23, wherein said oil soluble molybdenum compound is obtained by reacting a molybdenum source with a fatty acid and a 2-(2-aminoethyl)aminoethanol.

45. A lubricating composition according to claim 22 or 23, wherein the secondary diarylamine has from 6 to 30 carbon atoms in each of the aryl groups.



46. A lubricating composition according to claim 22 or 23, wherein the secondary diarylamine is of the formula:



wherein  $\text{R}^1$  and  $\text{R}^2$  each independently represent an aryl group having from 6 to 30 carbon atoms.

47. A lubricating composition according to claim 46, wherein at least one of said aryl groups has from 7 to 20 carbon atoms.

48. A lubricating composition according to claim 46, wherein each of the aryl groups of the amine is selected from phenyl, naphthyl, alkphenyl and alknaphthyl wherein the alkyl portion has from 4 to 18 carbon atoms.

49. A lubricating composition according to claim 46, wherein both aryl groups are alkaryl having from 7 to 20 carbon atoms.

50. A lubricating composition according to claim 46, wherein each aryl group is alkphenyl having from 6 to 18 carbon atoms in each alkyl group.

51. A lubricating composition according to claim 22 or 23, wherein said lubricating composition further comprises at least one of the following additives: a dispersant; a detergent; and a zinc dihydrocarbyl dithiophosphate.

52. A method for improving the antioxidancy and friction properties of a lubricant which comprises

including in the lubricant a molybdenum compound which is at least substantially  
5 free of phosphorus and is at least substantially free of active sulfur, said molybdenum  
compound providing about 100 to 450 parts per million of molybdenum to the lubricant,  
and about 750 to 5000 parts per million of an oil soluble secondary diarylamine.

53. A method for lubricating an automotive or truck crankcase or transmission  
10 comprising adding a lubricating composition according to claim 22 or 23 to said  
crankcase or transmission.

54. A lubricated automotive or truck crankcase or transmission obtained  
according to claim 53.

ADD  
B<sup>1</sup>

ADD  
C<sup>2</sup>

ADD  
D<sup>2</sup>